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Ecological engineering: from concepts to applications

Waterfowl habitat restoration in a seasonal island wetland

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Abstract

The wetland of Chortarolimni is an island, seasonal wetland with brackish waters. Due to a drainage ditch installed in the 1970s the breeding wildfowl of the wetland (Mallard, Common Shellduck, Ruddy Shellduck, Black-winged stilt and Eurasian Coot) suffers from the early seasonal draught. After an ecological assessment of the site, which involved a site visit and analysis of previous reports on the wetland, restorative measures were identified and designed to conserve the breeding waterfowl by enhancing the availability of open water and pond habitats during the waterfowl breeding period. Successful monitoring of the restoration measures will enhance the wetland ecosystem services and the ecotourism potential of the area.

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Keywords: Chortarolimni; Greece; habitat; island; restoration; waterfowl; wetland

1. Introduction

The ecological importance of wetlands as wildlife habitats is attributed to the high biodiversity and productivity they maintain, and to the fact that they support globally threatened bird species. Humanity has also benefited from the multiple functions of wetlands, using them as a source of food, water and fuel. However, in an effort to combat malaria as well as extending arable land, drainage has been the commonest management practice until the 1980s. Wetlands are being lost faster than any other ecosystem, despite the major restoration efforts that have begun in the recent decades [1,2,3].

The wetland of Chortarolimni is located on the island of Lemnos in the north Aegean Sea in Greece (Fig. 1). It is part of a Natura 2000 protected area network, which consists of unspoiled ecosystems of great ecological and aesthetical value. The area is favored by a significant number of bird species as their wintering, resting, feeding and/or breeding grounds. More specifically, Chortarolimni is the chosen breeding ground for the Mallard (*Anas platyrynchos*), the Ruddy Shellduck (*Tadorna ferruginea*), the Common Shellduck (*Tadorna tadorna*), the Black-winged Stilt (*Himantopus himantopus*), and the Eurasian Coot (*Fulica atra*) [4]. From these species, the Greek populations of Ruddy Shellduck and the Black-winged Stilt are considered endangered, while the Common Shellduck is considered vulnerable. Chortarolimni is a seasonal, brackish marsh, with waters retrieving during the dry summer months. A draining ditch that has been constructed in the 1970s for military purposes causes the waters

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to withdraw/evaporate early with negative consequences to the survival of the breeding waterfowl. Wildfowl has been observed by the locals to venture in the nearby villages during the dry period in search for water sources.

The aim of the present study is to identify simple habitat restoration measures so as to conserve the waterfowl species that breed in Chortarolimni by enhancing the availability of open water and pond habitats during the waterfowl breeding period.

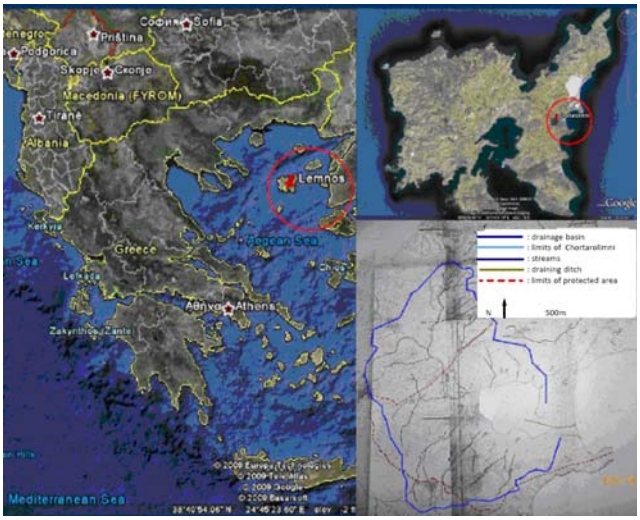

Fig. 1. Location and Drainage basin of Chortarolimni

2. Methods

The ecological condition of the Chortarolimni wetland was assessed using past studies [4,5] and the breeding waterfowl species were identified to serve as the target species for the habitat restoration design. Using the maximum depth (1.0 m) and surface area of the wetland (2.300 ha), an approximate model of the wetland shape was designed to allow water level calculations in response to the inflow and outflow of water as predicted by the water budget. All available weather data were collected from the local weather stations and processed together with the wetland shape model in order to calculate the water budget of the wetland based on the standard water budget equation [6] and a simplified version of the Pennman equation for evapotranspiration [7].

The site was visited in the end of the dry period (September 2009), in order to measure the level of the underground aquifer. Using the wetland water budget, the water level effect of a sluice installation at the draining ditch was calculated. Three ponds were designed and spaced inside the wetland area, taking into account the habitat requirements of the target species and the aquifer level. A flexible and methodical restoration monitoring plan was developed to follow the progress of the restoration works.

3. Results

The wetland shape that is designed allows simple trigonometrical calculations of water level with and without the use of a sluice. Installation of 45 cm sluice at the draining ditch is predicted to provide water for target species during dry period. Comparison of calculative and observational water levels, allows estimation of groundwater outflow at 1,200 m^3/year.

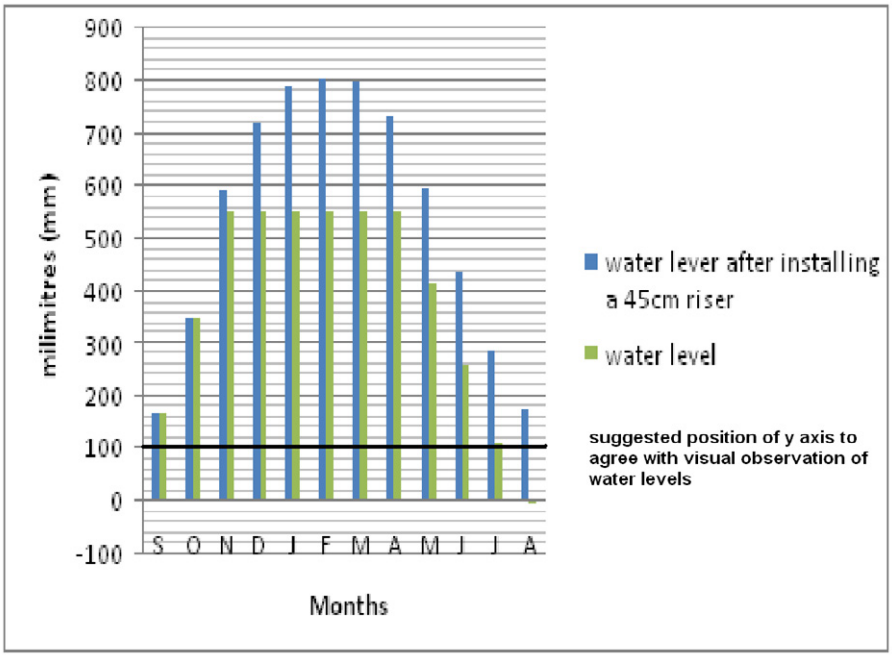

Fig. 2. Suggested wetland shape (left) and estimated wetland water level after installing a riser

All the target species require habitats with shallow banks and some area of open water, while the Mallard is the only diver. Taking into account the habitat requirements for the target species, and the possibility of the sluice not sufficing to provide the necessary water, three ponds were designed and spaced into the wetland area so as to reach the underground aquifer levels (-1.50 m) and to serve as suitable habitats for the breeding waterfowl (Figs. 3, 4).

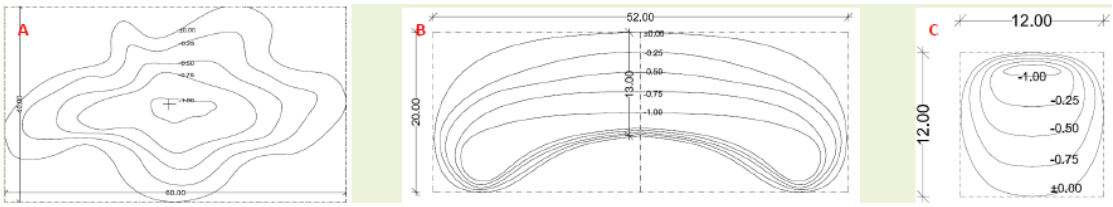

Fig. 3. Excavated pond design and dimensions (m).
The ground level is shown as ±0.00m, and the deepest point in all 3 ponds is -1.00m reaching underground aquifer. Depth contours (isobaths) and pond dimensions indicate steepness of the banks

Fig. 4. Suggested positions for excavated ponds

4. Discussion

The island location of Chortarolimni, adds an additional ecological importance to its conservation as small island wetlands are not common. Furthermore, it is a coastal wetland that does not have influx from the sea, a fact that makes the wetland both interesting and distinctive.

The breeding birds of the wetland require water for their moulting period and until the young are able to fly. For this reason water is needed in the wetland until the end of July. Two potential ways of intervention were identified. First by installing a sluice at the draining ditch so as to prevent the outflow of the waters into the sea; and second by excavating ponds inside the wetland taking advantage of the underground aquifer.

The approximate model of the wetland allows calculation of the water level fluctuation throughout the year, with and without installing a sluice (Fig. 2). The calculated water level differed to the observed water levels, allowing the estimation of the water that is lost through the ground. The wetland model predicts that with the installation of a 45 cm sluice there will be enough water for the breeding waterfowl species during the dry period.

Considering the underground aquifer and the guidelines for constructing ponds for waterfowl use [8], three ponds were designed to provide water for the breeding waterfowl (Fig. 3). The variability in pond shape and size, and also bank slope provides availability for waterfowl habitat and also areas of open water. Furthermore, the variability allows the observation of the waterfowl and the colonisation of vegetation to the different ponds so as to establish the best pond features for the breeding waterfowl specifically in Chortarolimni. The ponds are spaced at the deepest part of the wetland so as to minimize the necessary digging required (Fig. 4). Pond C is located near the already existing bird watching tower, allowing visual observation of the birds by the visitors. The excavated material is suggested to be deposited near the ponds (Fig. 4), so as to create small islands that can be used by the waterfowl to nest and rest, providing them with some shelter from predators.

The ideal time period of the construction phase of the restoration plan would be the end of the dry period (early September). During that time the wetland is not visited by waterfowl and the dry ground allows easy access for the excavators. Following the construction, monitoring the progress of the works is of great importance in order to

identify mishaps and take corrective action on time. Monthly measurements of water level, of waterfowl usage of the ponds, and of the succession of vegetation on the pond slopes would be required to provide the degree of success of the restoration plan.

5. Conclusions

The approach into developing a restoration plan for the wetland of Chortarolimni was consistent with the RAMSAR (Convention of Wetlands of International Importance) principles and guidelines for wetland restoration. The restorative measures that were identified in this study are simple and are predicted to suffice in providing the waterfowl with the appropriate habitat. With a systematic monitoring of the ecosystem response to the restorative measures, results will be of value in further restorative designs in Chortarolimni and/or other similar wetlands.

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